Name _____

Genes and Probability:
Applying Laws of Chance to Genetics

Background

Chance influences the inheritance of traits. Geneticists use probability to explain how traits are inherited. When you toss a coin, there is a 50:50 or 1 out of 2 chance that the coin will land as "heads" or as "tails." The same principle is applied to inheritance of traits to determine the probability or likelihood that a particular result is expected to occur.

In addition to chance, geneticists use a diagram called a "Punnett Square," named for its inventor, Reginald Punnett, to predict possible ways genes can combine during fertilization. A simple monohybrid cross – a cross that provides data about one trait – is the simplest form of a Punnett Square.

During gametogenesis, each chromosome of a pair separates and goes to one of the two gametes produced. The two alleles for a trait separate as the chromosomes on which they are located separate. During fertilization, new pairs of chromosomes and alleles are created.

In this activity you will compare the expected results of a monohybrid cross - obtained by completing a Punnett square – to the actual results of a monohybrid cross obtained by tossing coins. One coin represents the two possible female gametes of a monohybrid and the second coin represents the two possible male gametes of the same monohybrid. A toss of the coins models a self-pollination, or fertilization.

A. Expected Results

Complete the Punnett square below of a monohybrid cross with the genotypes Hh ("H" for heads and "h" for tails) to determine how often each possible genotype combination is expected to be passed on in four offspring. Fill in the genotype ratio and then answer the questions to the right.

(Female Gametes)

(Male Gametes)	H	h
H		
h		

Genotype Ratio _____

a. How many offspring with the genotype HH could be expected? _____
b. How many offspring with the genotype Hh or hH could be expected? _____
c. How many offspring with the genotype hh could be expected _____
d. What are the four possible genotype combinations of these gametes when they recombine during fertilization?
_____

B. Actual Results

Now use the 2 plastic coins to see if your expected results from the Punnett square match your actual results. Place 2 plastic coins in a cup. One of the coins represents the female gametes while the other represents the male gametes. Both have undergone meiosis. Shake the cup and toss the coins on your desk. Repeat this step a told of 20 times. Record your results in Table 1 below by placing an "X" in the appropriate column.

Remember, "H" represents heads and "h" represents tails.

Table 1

Toss	Genotypes		
	HH	Hh or hH	hh
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
Total			
Genotype Ratio			

C. Ratios

Calculate the ratios of each genotype as follows to complete the last 2 rows of your table:

- Determine the total number of each genotype (HH, Hh or hH, and hh) obtained after 20 tosses by adding your results from each column.
- Divide the results for each genotype by the total number of tosses (20). This will result in a decimal. Multiply that decimal by 4 to obtain the genotype ratio.

D. Class Results

Record the total number of each resulting genotype from the class data on the board. Then calculate the ratios of each genotype by dividing those results by the total number of tosses for the class. Multiply the resulting decimals by 4 to obtain the genotype ratio. Record the class results in Table 2 below.

Table 2

Class Results	Genotypes		
	HH	Hh or hH	hh
Total Number			
Genotype Ratio			

Questions

1. How does the ratio calculated from your coin tosses compare to the expected results determined with the Punnett square?

2. How can you explain that your calculated ratio may not be exactly the expected results? Were the class results close to the expected results? Explain.